

WHAT IS CLAIMED IS:

1. A compound represented by the nominal general formula:



wherein:

- (i) A is selected from the group consisting of elements from Group I of the Periodic Table, and mixtures thereof, and  $0 < a \leq 9$ ;
- (ii) at least one of M, MI and MII is a redox active element,  $0 < m, n, o \leq 4$ , and  $\frac{1}{2}[V(MI) + V(MII)] = V(M)$ , wherein  $V(M)$  is the valence state of M,  $V(MI)$  is the valence state of MI, and  $V(MII)$  is the valence state of MII;
- (iii)  $XY_4$  is selected from the group consisting of  $X'[O_{4-x},Y'_x]$ ,  $X'[O_{4-y},Y'_{2y}]$ ,  $X''S_4$ ,  $[X_2''',X'_{1-z}]O_4$ , and mixtures thereof, wherein:
  - (a)  $X'$  and  $X'''$  are each independently selected from the group consisting of P, As, Sb, Si, Ge, V, S, and mixtures thereof;
  - (b)  $X''$  is selected from the group consisting of P, As, Sb, Si, Ge, V, and mixtures thereof;
  - (c)  $Y'$  is selected from the group consisting of a halogen, S, N, and mixtures thereof; and
  - (d)  $0 \leq x \leq 3$ ,  $0 \leq y \leq 2$ ,  $0 \leq z \leq 1$ , and  $1 \leq d \leq 3$ ; and
- (iv) Z is selected from the group consisting of a hydroxyl (OH), a halogen, and mixtures thereof, and  $0 \leq e \leq 4$ ;

wherein A, M, MI, MII X, Y, Z, a, m, n, o, d, and e are selected so as to maintain electroneutrality of the compound.

2. The compound of Claim 1, wherein A is selected from the group consisting of Li, K, Na, and mixtures thereof.
3. The compound of Claim 1, wherein A is Li.
4. The compound of Claim 1, wherein M, MI and MII are each a redox active element.
5. The compound of Claim 4, wherein MI is selected from the group consisting of redox active elements with a 1+ oxidation state, 2+ oxidation state, 3+ oxidation state and mixtures thereof.
6. The compound of Claim 5, wherein at least one of M and MII is a non-redox active element.
7. The compound of Claim 5, wherein MI is selected from the group consisting of  $\text{Cu}^{1+}$ ,  $\text{Ag}^{1+}$  and mixtures thereof
8. The compound of Claim 7, wherein at least one of M and MII is a non-redox active element.
9. The compound of Claim 5, wherein MI is selected from the group consisting of  $\text{Ti}^{2+}$ ,  $\text{V}^{2+}$ ,  $\text{Cr}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Mo}^{2+}$ ,  $\text{Si}^{2+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Pb}^{2+}$ , and mixtures thereof.

10. The compound of Claim 9, wherein at least one of M and MII is a non-redox active element.

11. The compound of Claim 5, wherein MI is selected from the group consisting of  $\text{Ti}^{3+}$ ,  $\text{V}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Mn}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Co}^{3+}$ ,  $\text{Ni}^{3+}$ ,  $\text{Mo}^{3+}$ ,  $\text{Nb}^{3+}$ , and mixtures thereof.

12. The compound of Claim 11, wherein at least one of M and MII is a non-redox active element.

13. The compound of Claim 1, wherein MI is selected from the group consisting of non-redox active elements with a 1+ oxidation state, 2+ oxidation state, 3+ oxidation state and mixtures thereof.

14. The compound of Claim 13, wherein one of M and MII is a non-redox active element.

15. The compound of Claim 13, wherein MI is selected from the group consisting of  $\text{Li}^{1+}$ ,  $\text{K}^{1+}$ ,  $\text{Na}^{1+}$ ,  $\text{Ru}^{1+}$ ,  $\text{Cs}^{1+}$ , and mixtures thereof.

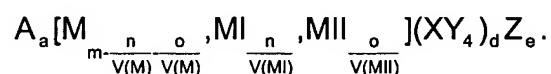
16. The compound of Claim 15, wherein one of M and MII is a non-redox active element.

17. The compound of Claim 13, wherein MI is selected from the group consisting of  $\text{Be}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{C}^{2+}$ ,  $\text{Ge}^{2+}$ .
18. The compound of Claim 17, wherein one of M and MII is a non-redox active element.
19. The compound of Claim 17, wherein MI is selected from the group consisting of  $\text{Be}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ , and mixtures thereof.
20. The compound of Claim 17, wherein MI is selected from the group consisting of  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ , and mixtures thereof.
21. The compound of Claim 17, wherein MI is selected from the group consisting of  $\text{C}^{2+}$ ,  $\text{Ge}^{2+}$ , and mixtures thereof.
22. The compound of Claim 13, wherein MI is selected from the group consisting of  $\text{Sc}^{3+}$ ,  $\text{Y}^{3+}$ ,  $\text{B}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Ga}^{3+}$  and mixtures thereof.
23. The compound of Claim 22, wherein one of M and MII is a non-redox active element.
24. The compound of Claim 1, wherein  $\text{XY}_4$  is selected from the group consisting of  $\text{PO}_4$ ,  $\text{AsO}_4$ ,  $\text{SbO}_4$ ,  $\text{SiO}_4$ ,  $\text{GeO}_4$ ,  $\text{VO}_4$ ,  $\text{SO}_4$ , and mixtures thereof.

25. The compound of Claim 1, wherein  $XY_4$  is  $PO_4$ .
26. The compound of Claim 1, wherein Z is selected from the group consisting of OH, F, Cl, Br, and mixtures thereof.
27. The compound of Claim 1, wherein Z is F.
28. The compound of Claim 1, wherein  $e = 0$ .
29. The compound of Claim 1, wherein the compound is represented by the nominal general formula:



30. The compound of Claim 1, wherein the compound is represented by the nominal general formula:



31. The compound of Claim 1, wherein  $d = 1$ ; A is Li; and  $XY_4 = PO_4$ .
32. The compound of Claim 1, wherein  $d = 3$ ; a is Li; and  $XY_4 = PO_4$ .

33. A battery, comprising:

a first electrode comprising a compound represented by the nominal general formula:



wherein:

- (i) A is selected from the group consisting of elements from Group I of the Periodic Table, and mixtures thereof, and  $0 < a \leq 9$ ;
- (ii) at least one of M, MI and MII is a redox active element,  $0 < m, n, o \leq 4$ , and  $\frac{1}{2}[V(MI) + V(MII)] = V(M)$ , wherein  $V(M)$  is the valence state of M,  $V(MI)$  is the valence state of MI, and  $V(MII)$  is the valence state of MII;
- (iii)  $XY_4$  is selected from the group consisting of  $X'[O_{4-x},Y'_x]$ ,  $X'[O_{4-y},Y'_{2y}]$ ,  $X''S_4$ ,  $[X_z''',X'_{1-z}]O_4$ , and mixtures thereof, wherein:
  - (a)  $X'$  and  $X'''$  are each independently selected from the group consisting of P, As, Sb, Si, Ge, V, S, and mixtures thereof;
  - (b)  $X''$  is selected from the group consisting of P, As, Sb, Si, Ge, V, and mixtures thereof;
  - (c)  $Y'$  is selected from the group consisting of a halogen, S, N, and mixtures thereof; and
  - (d)  $0 \leq x \leq 3$ ,  $0 \leq y \leq 2$ ,  $0 \leq z \leq 1$ , and  $1 \leq d \leq 3$ ; and
- (iv) Z is selected from the group consisting of a hydroxyl (OH), a halogen, and mixtures thereof, and  $0 \leq e \leq 4$ ;

wherein A, M, MI, MII X, Y, Z, a, m, n, o, d, and e are selected so as to maintain electroneutrality of the compound;

the battery further comprising a second counter-electrode comprising an intercalation active material; and

an electrolyte.

34. The battery of Claim 33, wherein A is selected from the group consisting of Li, K, Na, and mixtures thereof.

35. The battery of Claim 33, wherein A is Li.

36. The battery of Claim 33, wherein M, MI and MII are each a redox active element.

37. The battery of Claim 36, wherein MI is selected from the group consisting of redox active elements with a 1+ oxidation state, 2+ oxidation state, 3+ oxidation state and mixtures thereof.

38. The battery of Claim 37, wherein at least one of M and MII is a non-redox active element.

39. The battery of Claim 37, wherein MI is selected from the group consisting of  $\text{Cu}^{1+}$ ,  $\text{Ag}^{1+}$  and mixtures thereof

40. The battery of Claim 39, wherein at least one of M and MII is a non-redox active element.

41. The battery of Claim 37, wherein MI is selected from the group consisting of  $\text{Ti}^{2+}$ ,  $\text{V}^{2+}$ ,  $\text{Cr}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Mo}^{2+}$ ,  $\text{Si}^{2+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Pb}^{2+}$ , and mixtures thereof.

42. The battery of Claim 41, wherein at least one of M and MII is a non-redox active element.

43. The battery of Claim 37, wherein MI is selected from the group consisting of  $\text{Ti}^{3+}$ ,  $\text{V}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Mn}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Co}^{3+}$ ,  $\text{Ni}^{3+}$ ,  $\text{Mo}^{3+}$ ,  $\text{Nb}^{3+}$ , and mixtures thereof.

44. The battery of Claim 43, wherein at least one of M and MII is a non-redox active element.

45. The battery of Claim 33, wherein MI is selected from the group consisting of non-redox active elements with a 1+ oxidation state, 2+ oxidation state, 3+ oxidation state and mixtures thereof.

46. The battery of Claim 45, wherein one of M and MII is a non-redox active element.

47. The battery of Claim 45, wherein MI is selected from the group consisting of  $\text{Li}^{1+}$ ,  $\text{K}^{1+}$ ,  $\text{Na}^{1+}$ ,  $\text{Ru}^{1+}$ ,  $\text{Cs}^{1+}$ , and mixtures thereof.



48. The battery of Claim 47, wherein one of M and MII is a non-redox active element.
49. The battery of Claim 45, wherein MI is selected from the group consisting of  $\text{Be}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{C}^{2+}$ ,  $\text{Ge}^{2+}$ .
50. The battery of Claim 49, wherein one of M and MII is a non-redox active element.
51. The battery of Claim 49, wherein MI is selected from the group consisting of  $\text{Be}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ , and mixtures thereof.
52. The battery of Claim 49, wherein MI is selected from the group consisting of  $\text{Zn}^{2+}$ ,  $\text{Cd}^{2+}$ , and mixtures thereof.
53. The battery of Claim 49, wherein MI is selected from the group consisting of  $\text{C}^{2+}$ ,  $\text{Ge}^{2+}$ , and mixtures thereof.
54. The battery of Claim 45, wherein MI is selected from the group consisting of  $\text{Sc}^{3+}$ ,  $\text{Y}^{3+}$ ,  $\text{B}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Ga}^{3+}$  and mixtures thereof.
55. The battery of Claim 54, wherein one of M and MII is a non-redox active element.
56. The battery of Claim 33, wherein  $\text{XY}_4$  is selected from the group consisting of  $\text{PO}_4$ ,  $\text{AsO}_4$ ,  $\text{SbO}_4$ ,  $\text{SiO}_4$ ,  $\text{GeO}_4$ ,  $\text{VO}_4$ ,  $\text{SO}_4$ , and mixtures thereof.

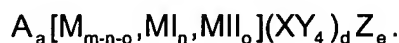
57. The battery of Claim 33, wherein  $XY_4$  is  $PO_4$ .

58. The battery of Claim 33, wherein Z is selected from the group consisting of OH, F, Cl, Br, and mixtures thereof.

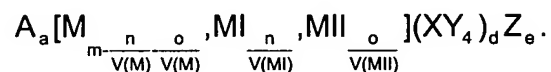
59. The battery of Claim 33, wherein Z is F.

60. The battery of Claim 33, wherein  $e = 0$ .

61. The battery of Claim 33, wherein the compound is represented by the nominal general formula:



62. The battery of Claim 33, wherein the compound is represented by the nominal general formula:



63. The battery of Claim 33, wherein  $d = 1$ ; A is Li; and  $XY_4 = PO_4$ .

64. The battery of Claim 33, wherein  $d = 3$ ; a is Li; and  $XY_4 = PO_4$ .

65. The battery of Claim 33, wherein the first electrode further comprises an electrically conductive diluent, and a binder.

66. The battery of Claim 65, wherein the electrically conductive diluent is carbon.
67. The battery of Claim 66, wherein the electrically conductive diluent is carbon black.
68. The battery of Claim 67, wherein the first electrode comprises from 5 to 30% by weight carbon black.
69. The battery of Claim 65, wherein the binder is a copolymer of polyvinylidene difluoride (PVdF) and hexafluoropropylene (HFP).
70. The battery of Claim 69, wherein the first electrode comprises from 3 to 20% by weight binder.
71. The battery of Claim 33, wherein the second electrode comprises an insertion active material.
72. The battery of Claim 71, wherein the insertion active material is selected from the group consisting of a metal oxide, metal chalcogenide, carbon, graphite, and mixtures thereof.
73. The battery of Claim 71, wherein the insertion active material is graphite.

74. The battery of Claim 71, wherein the first and second electrodes each further comprise an electrically conductive diluent, and a binder.
75. The battery of Claim 74, wherein the electrically conductive diluent is carbon.
76. The battery of Claim 75, wherein the electrically conductive diluent is carbon black.
77. The battery of Claim 76, wherein the first and second electrode each comprise from 5 to 30% by weight carbon black.
78. The battery of Claim 77, wherein the binder is a copolymer of polyvinylidene difluoride (PVdF) and hexafluoropropylene (HFP).
79. The battery of Claim 77, wherein the first and second electrode each comprise from 3 to 20% by weight binder.
80. The battery of Claim 33, wherein the electrolyte comprises a lithium salt and a solvent selected from the group consisting of dimethyl carbonate (DMC), diethylcarbonate (DEC), dipropylcarbonate (DPC), ethylmethylcarbonate (EMC), ethylene carbonate (EC), propylene carbonate (PC), butylene carbonate, lactones, esters, glymes, sulfoxides, sulfolanes, and mixtures thereof.

81. The battery of Claim 80, wherein the electrolyte comprises a solvent selected from the group consisting of EC/DMC, EC/DEC, EC/DPC and EC/EMC.

82. The battery of Claim 80, wherein the electrolyte comprises from 5% to 65% by weight lithium salt.

83. The battery of Claim 82, wherein the electrolyte comprises from 8% to 35% by weight lithium salt.